



2010

Monitoring Report



Why monitor our waters?

The Middle Fork Crow River Watershed District (MFCRWD) was formed in 2005 to protect and preserve water quality in the watershed. Monitoring plays a vital role for the District to achieve this goal. Results from our monitoring program help us assess water quality trends in the watershed and provide information on where to target best management practices. To help track long term changes, 11 permanent stream sites have been established and the 8 major lakes in the watershed are monitored annually. Monitoring is conducted by District staff and several volunteers. In 2010, the MFCRWD was able to team up with 6 lake associations to increase the frequency of sampling on their lakes from once per month to twice, which provides for more robust data on those lakes. To determine if we are reaching water quality goals, monitoring data is evaluated on an annual basis.

The monitoring program is funded through two sources. A Clean Water Partnership Continuation grant from the Minnesota Pollution Control Agency provides the majority of funding and the Calhoun Lake Association, Diamond Lake Area Recreation Association, George Lake Association, Green Lake Property Owners Association, Long Lake Association, and Nest Lake Improvement Association all provide additional funding for their respective lakes.

This report provides an assessment of the data collected by the MFCRWD volunteers and staff from 2007 to 2010. The report forms part of a long term effort to track water quality trends throughout the watershed.

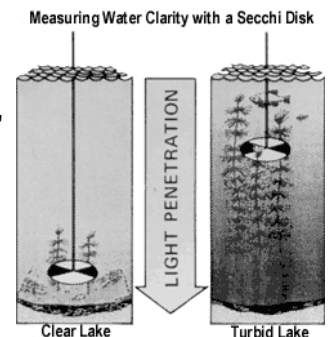
Monitoring Methods and Tools

Volunteers and staff members monitor lake and stream water quality, stream flow and precipitation throughout the watershed using secchi disks, transparency tubes, flow gauging equipment, and rain gauges.

Secchi Disk

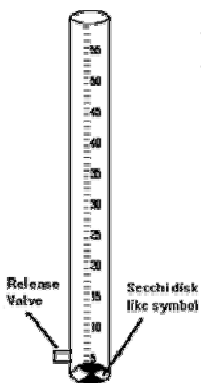
One of the most common tools used to measure overall lake water quality is the secchi disk. Secchi disk measurements over time can give a general indication of problems in a lake by estimating the water clarity, or turbidity. Turbidity is suspended materials such as algae, silt and organic matter in the water.

A secchi disk is a weighted circular metal disk 8 inches in diameter, attached to a rope marked for measurement. The disks are black and white or all white in color. To collect a secchi disk measurement, the disk is lowered into the water column until it disappears. The secchi depth is measured by recording the depth at which the disk reappears. Deeper secchi disk readings (larger numbers) indicate clearer water.



Transparency Tube

In rivers and streams, soil particles such as sand, silt and clay are carried and deposited with the current. When there is too much material suspended in the water, the water transparency, or clarity decreases. Low transparency readings can be indicative of an erosion problem within the river or the river's watershed. As sand, silt and clay (sediment) levels increase, the river or stream may become unsuitable for fish and other aquatic species.



Transparency is measured using a transparency tube, or t-tube. To collect a t-tube reading, the tube is filled with water from the flowing stream. While looking down the tube, water is released through a valve at the bottom of the tube until the black and white disk at the bottom of the tube is faintly visible. This depth is recorded. More water is then released until the disk is completely visible; the second measurement is recorded. The t-tube reading is an average of the two readings. If the disk is fully visible when the tube is filled, the reading reflects >100 cm. In general, low t-tube readings indicate high levels of sediment suspended in the stream. A greater t-tube reading reflects better water clarity.

Grab Samples

Grab samples provide insight into the chemical condition of the water body and determine its suitability for fisheries, recreational activities, and groundwater recharge. They also become an important gauge of potential land use problems in the watershed. Stream samples were collected monthly or bimonthly from May through September and tested for Total Phosphorus (TP), Total Suspended Solids (TSS), and Total Kjeldahl Nitrogen (TKN). Lake samples were collected monthly or bimonthly also from May through September and tested for TP, TSS and Chlorophyll-a (Chl-a).

The Importance of Chemistry

Phosphorus – Phosphorus is one of the key elements necessary for growth of plants and animals. If too much phosphorus enters the waterway, algae and aquatic plants will grow excessively and choke up the waterway. As the algae and plants die, their decomposition depletes the water body's oxygen supply, leading to the loss of aquatic life. Some sources of phosphorus include cropland (fertilizer and soil), human and animal waste, and stormwater runoff from development.

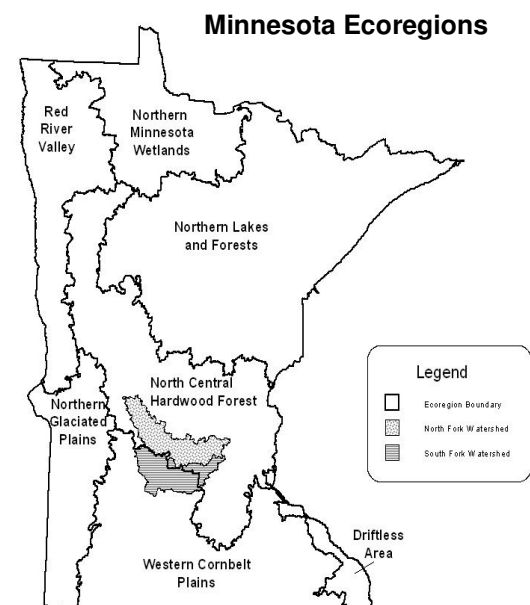
Total Suspended Solids – Materials suspended in the water column can decrease the diversity of aquatic organisms and increase the water temperature. Plant populations can decrease as the suspended materials block the ability of sunlight to penetrate the water. Fish populations and other aquatic organisms suffer when eggs are smothered by silt and clay. The material suspended in the water can be both organic (plankton, sewage) and inorganic (silt, clay). By measuring total suspended solids, we can begin to determine the effects of runoff on a water body.

Chlorophyll-a – Chlorophyll-a is the pigment in plants that make them look green. Measuring chlorophyll-a indicates the amount of algae in the water column.

Total Kjeldahl Nitrogen (TKN) – TKN is a form of nitrogen that is used as an indicator for the presence of manure or sewage in water bodies.

Data Results and Discussion

When reviewing stream and lake data, it is useful to have a reference or average value to compare the data with. Water quality values found in southern Minnesota would be expected to be different than those found in northern Minnesota because of differences in precipitation patterns, land cover, soils, topography, land use practices, etc. Therefore, rather than a statewide average or reference, **Ecoregional Averages** are used. These are developed with



the use of ecoregional reference lakes and streams that have been minimally impacted by pollution. Data that represents the lower and upper boundaries of the reference water bodies are used as comparison values. Under most circumstances, we expect water quality results in our watershed to fall within the ranges of the reference water bodies. Chemistry samples with lower readings indicate better water quality while higher secchi disk and t-tube readings represent water that is clearer. The Middle Fork Crow River watershed is located in the North Central Hardwood Forest ecoregion.

Stream and River Water Quality

The MFCRWD has established 11 permanent stream sites in the watershed that are monitored for transparency and chemistry; continuous flow monitoring is conducted at 4 of these sites for modeling purposes. Whenever data results are being reviewed, it is important to emphasize that the four years of data in this report can only give a “snapshot” of what is happening in a particular lake or river reach, but this “snapshot” can signify seasonal trends along a watercourse or areas of concern. Sites are shown upstream to downstream from left to right on the following graphs.

Modeling Our Data

To further analyze the water quality data that is collected by staff and volunteers, the water quality model FLUX is used. FLUX was designed by the U.S. Army Corps of Engineers. The program uses concentrations from grab samples paired with instantaneous flow measurements and a continuous flow record to estimate annual loadings of sediment and nutrients. Fluctuations in annual sediment and nutrient loadings are influenced by the volume of water in the river system and the concentration of sediment or nutrients.

A map with the location of our monitoring sites is on the last page of the report.

Chart 1 shows the average annual transparency tube (t-tube) readings from 2007 through 2010. Note that prior to 2009, the District was using 60 cm t-tubes and in 2009 began using 100 cm t-tubes. This accounts for the jump in water clarity. Higher t-tube readings indicate better water quality. In 2010 all of the monitoring sites were in the excellent range.

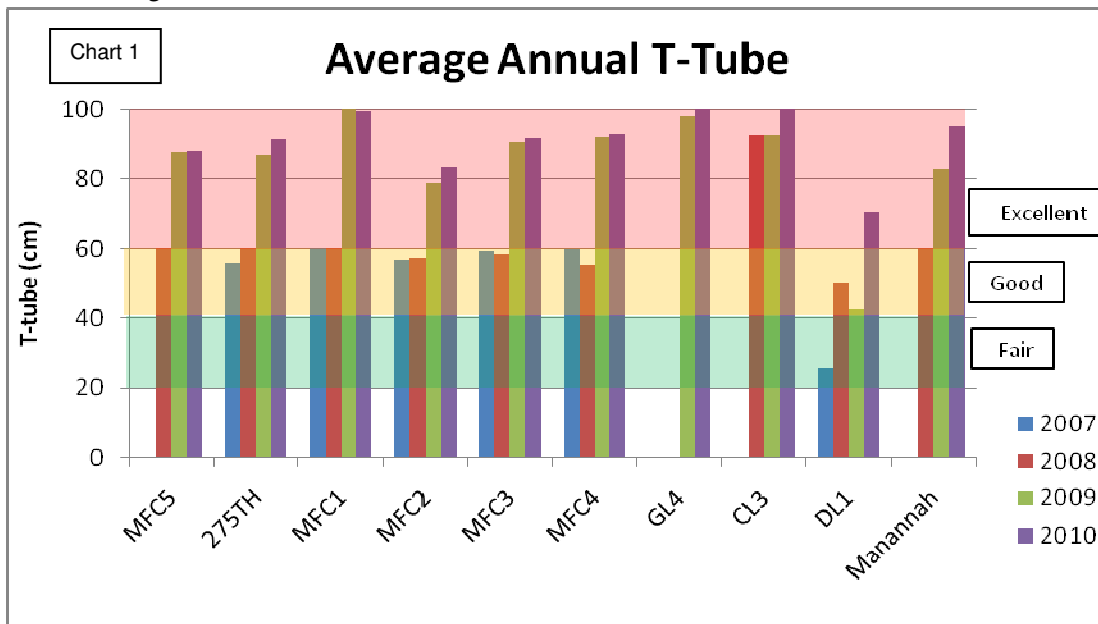


Chart 2 shows the average annual flow volume as recorded by the continuous flow equipment at four river sites. Typically the volume of water increases from upstream to downstream in the watershed. The amount of storage in the watershed in the form of lakes can affect this trend. Lower lake levels allow more water to be stored and lower volumes of flow to reach downstream sites.

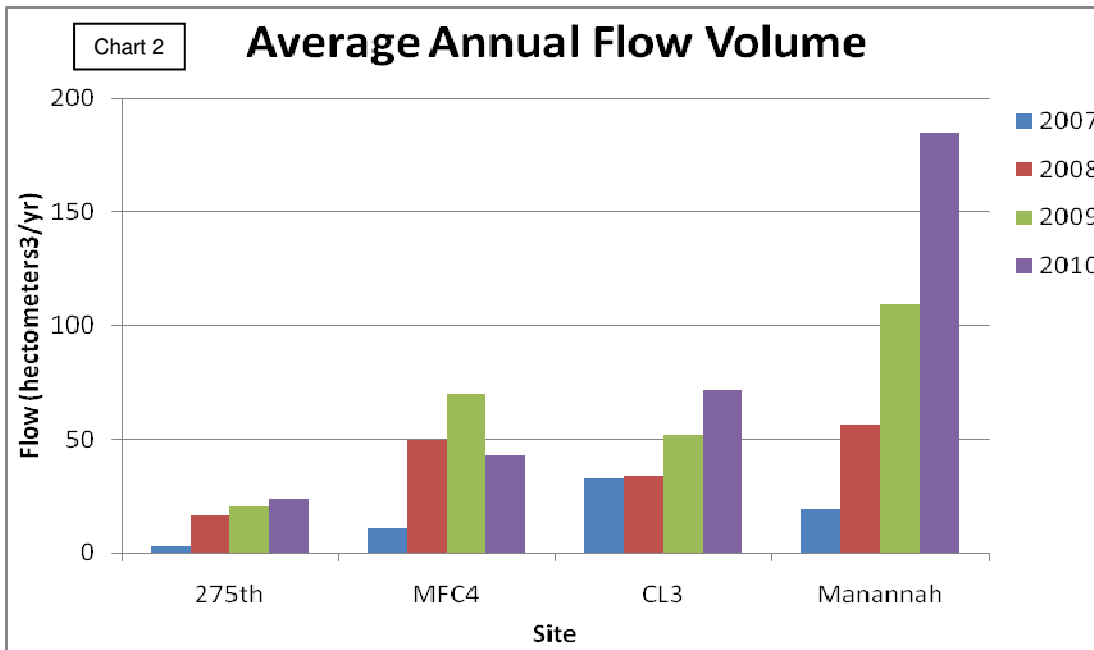


Chart 3 shows the average annual stream total phosphorus (TP) readings from 2007 through 2010. The shaded area indicates the ecoregional average for TP. In 2010, six sites (MFC5, 275th, MFC1, MFC2, MFC3, MFC4, GL4, CL3 and Manannah) were within or better than the ecoregional average. One site, DL1, was higher than the ecoregional average, indicating poor water quality.

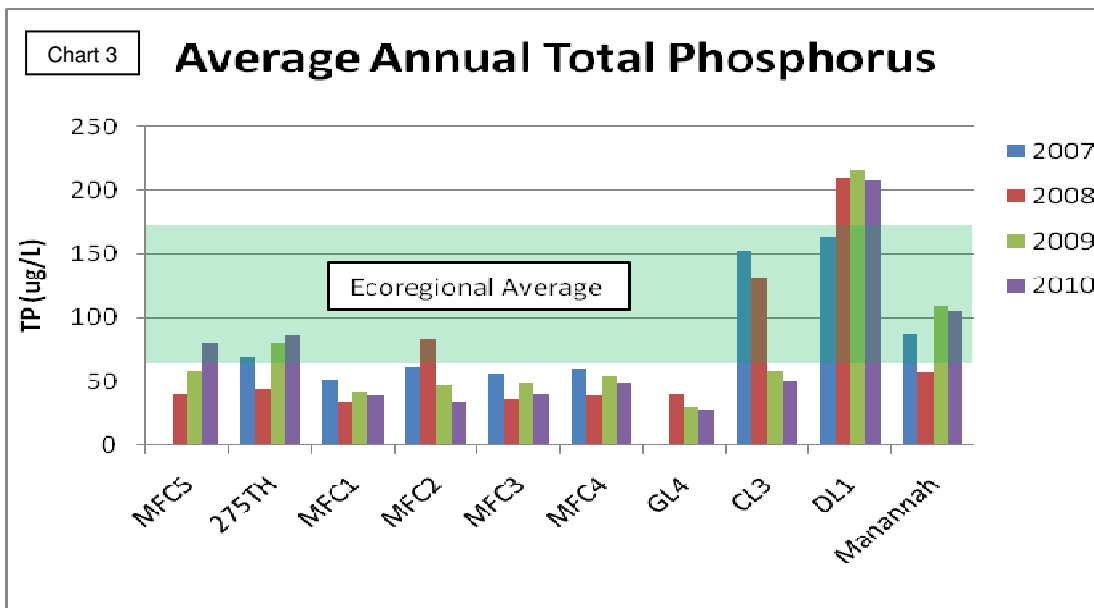


Chart 4 shows the annual total phosphorus (TP) *load* at four river sites. These loads were calculated using the FLUX water quality model. Generally, TP loads tend to increase from upstream to downstream. This is not necessarily due to an increase in the concentration of phosphorus, but may be contributed to the increased volume of water and larger watershed draining into the river at each consecutive downstream location. 2010 was a year with more precipitation and therefore increased flow in the river, which contributed to the increased phosphorus load.

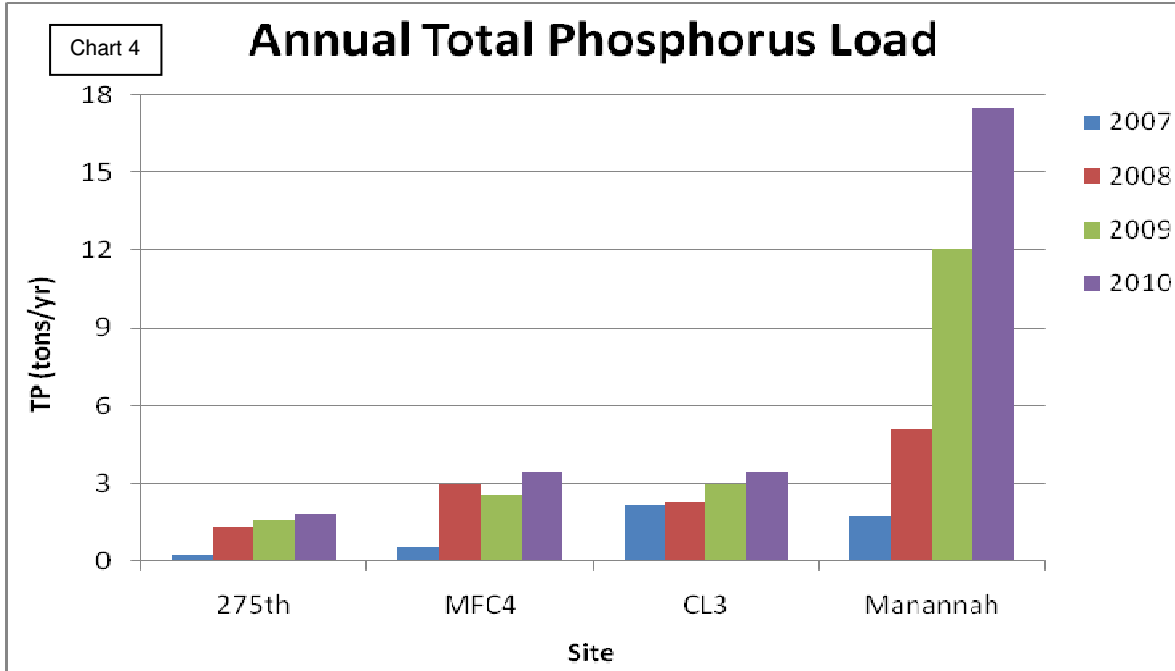


Chart 5 shows the average annual total suspended solids (TSS) from 2007 through 2010. The shaded box depicts the ecoregional average for TSS. In 2010, all ten sites monitored were within or better than ecoregional averages, indicating good water quality.

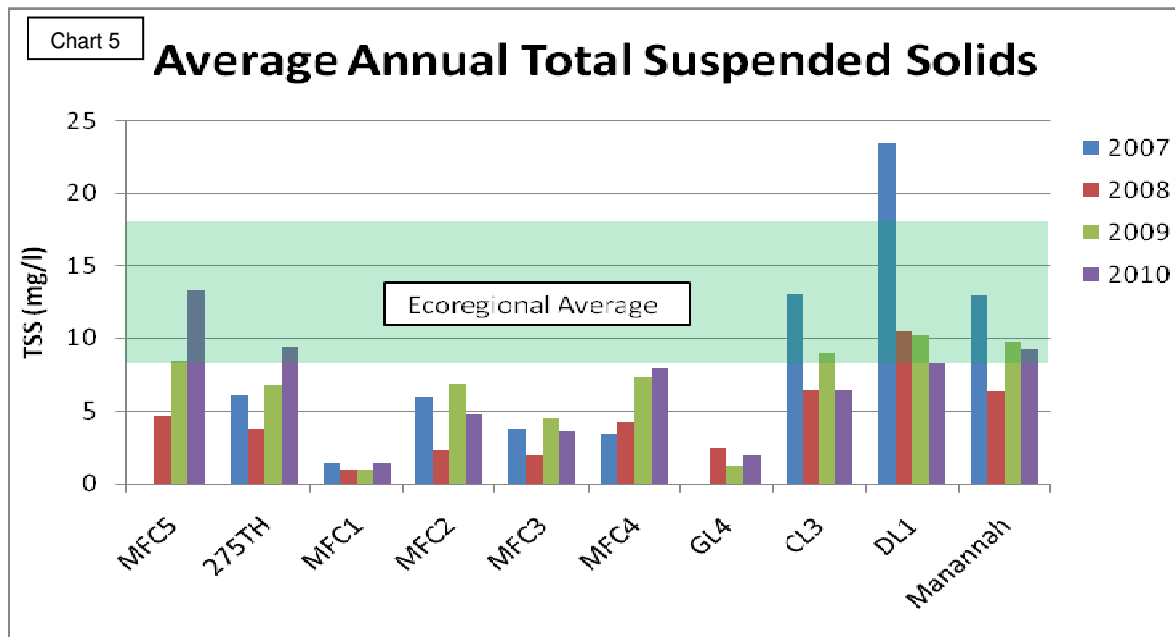
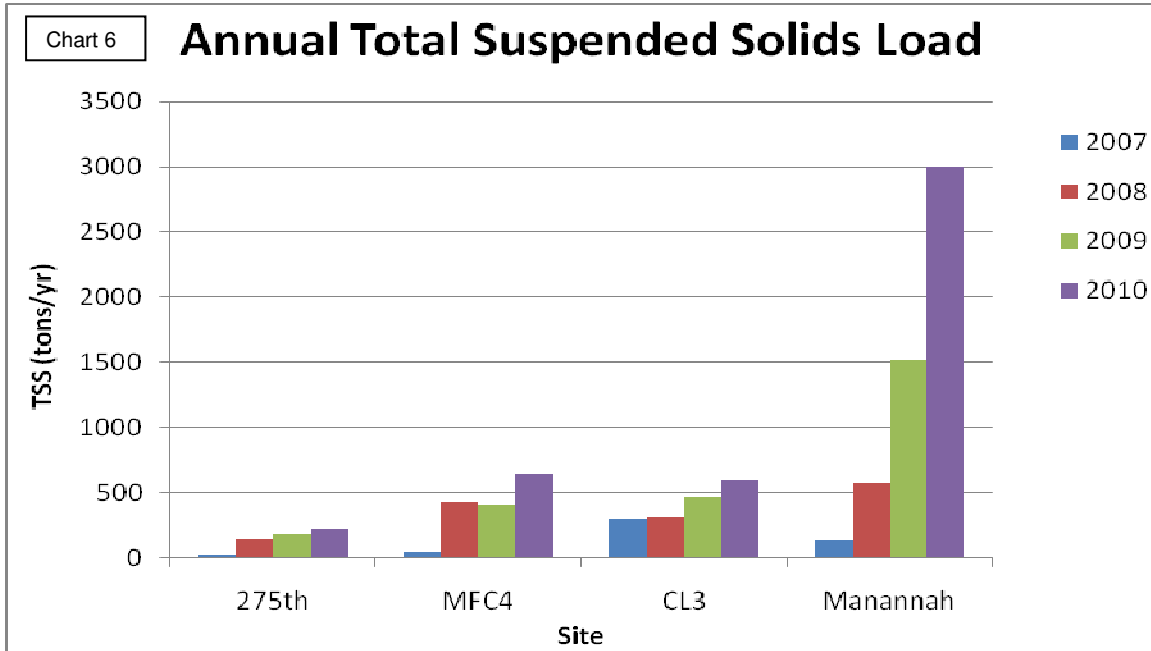


Chart 6 shows the annual total suspended solids (TSS) load at four river sites. These loads were calculated using the FLUX water quality model. As with total phosphorus, the TSS load tends to increase from upstream to downstream. This is a reflection of the increased volume of water rather than an increase in the concentration of sediment in the water. As with total phosphorus loads, the increased precipitation and flow contributed to the increase in the total suspended solids load in the river.



Lake Water Quality

The 8 major lakes in the MFCRWD are monitored annually. When interpreting data results from any water body, it is important to note that readings from at least ten years are necessary to show any true trend in water quality. However, a few years of data can provide a “snapshot” of the lake’s health.

Chart 7 shows the average annual secchi disk readings. The shaded box indicates the ecoregional average for deep lakes – those with an average depth greater than 15 feet. Calhoun and Monongalia lakes are considered shallow lakes - lakes with an average depth 15 feet or less – and therefore have a different standard. In the chart, the red line indicates the minimum ecoregional average for shallow lakes. Since secchi disk is a measurement of water clarity in a lake, a higher number indicates better clarity. The average secchi disk reading in 2010 on Diamond Lake was below the ecoregional average, indicating poor water clarity. Nest Lake fell within the ecoregional average meaning that water clarity was satisfactory. Long, George, Elkhorn, Monongalia, Calhoun and Green lakes were better than ecoregional averages, meaning these lakes are clearer than most lakes in the ecoregion.

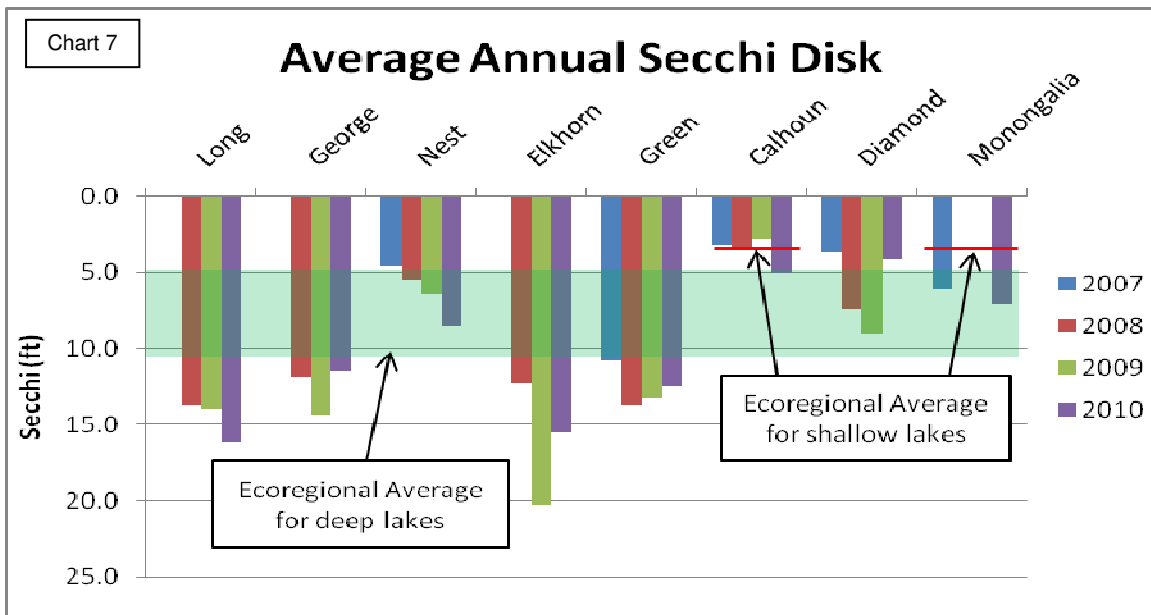


Chart 8 shows the results for average annual chlorophyll-a (Chl-a) from 2007 through 2010. The shaded area depicts the ecoregional average for Chl-a. In 2010, Calhoun, Elkhorn, George, Green, Long, Monongalia, and Nest lakes were within or better than ecoregional averages, representing good to excellent water quality. Diamond Lake exceeded the ecoregional average indicating poor water quality.

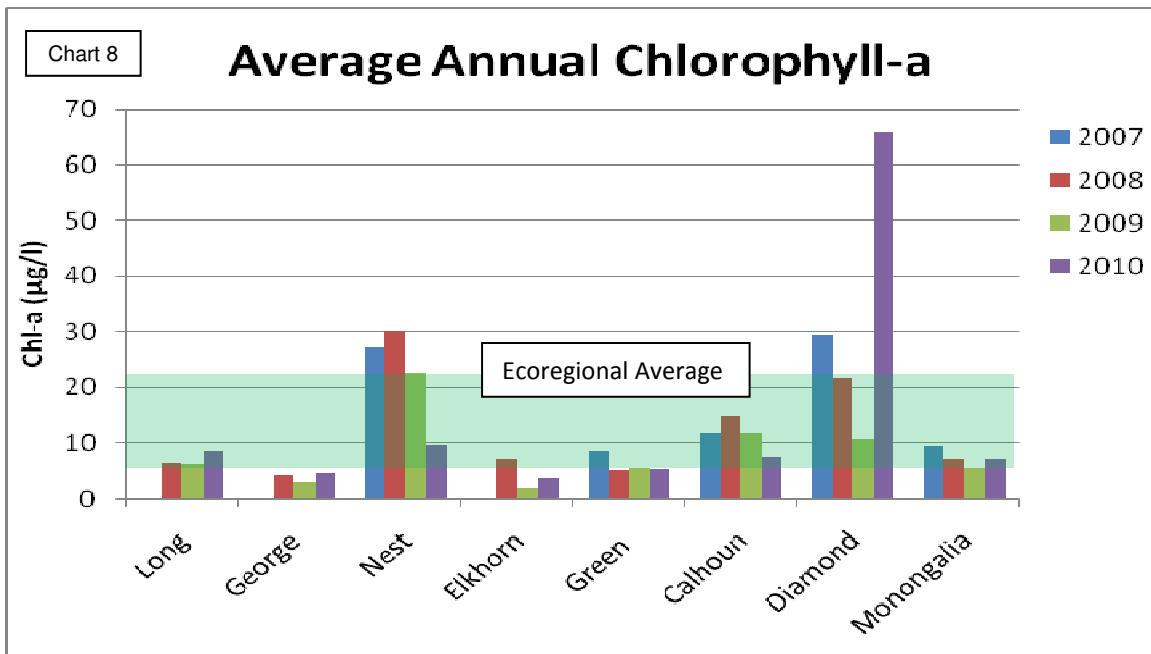


Chart 9 shows the results for average annual total suspended solids (TSS) from 2007 through 2010. The shaded area indicates the ecoregional average for TSS. In 2010, Long, George, Nest, Elkhorn, Green, Calhoun and Monongalia were within or better than ecoregional averages, indicating good to excellent water quality. Diamond Lake exceeded the ecoregional average, indicating poor water quality.

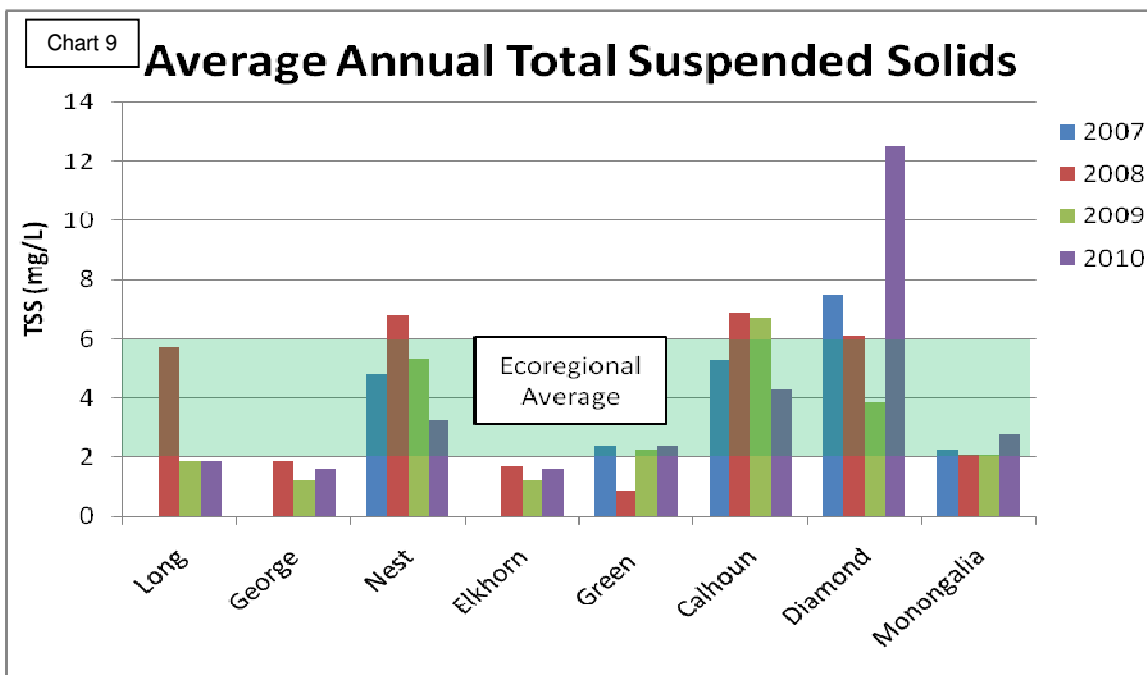
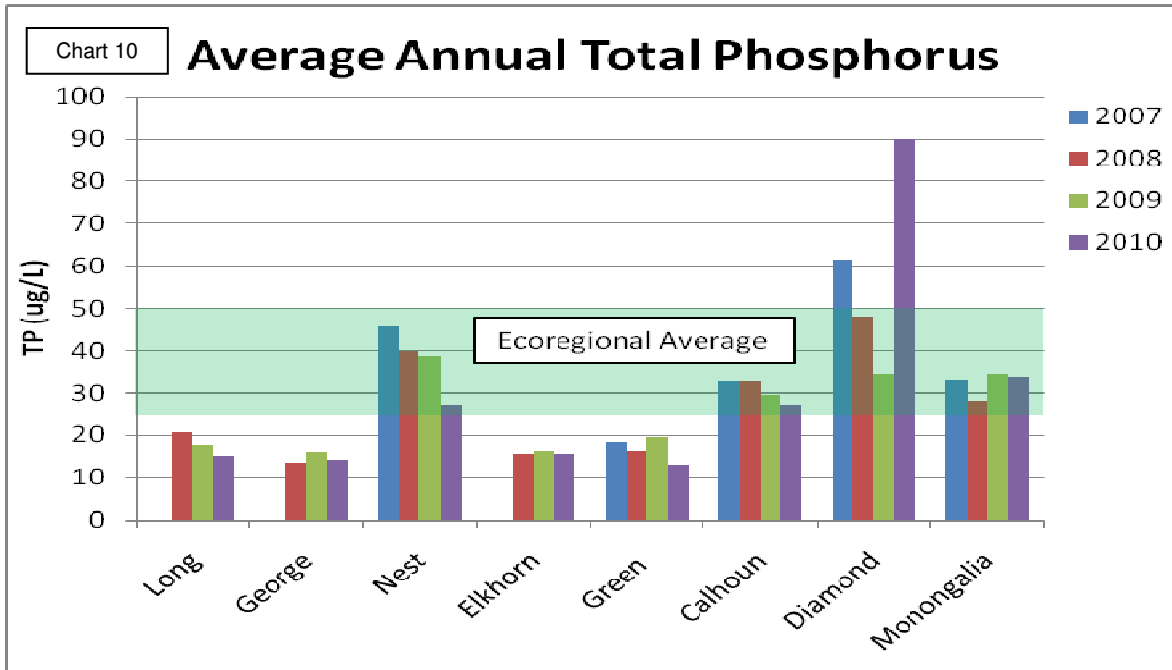
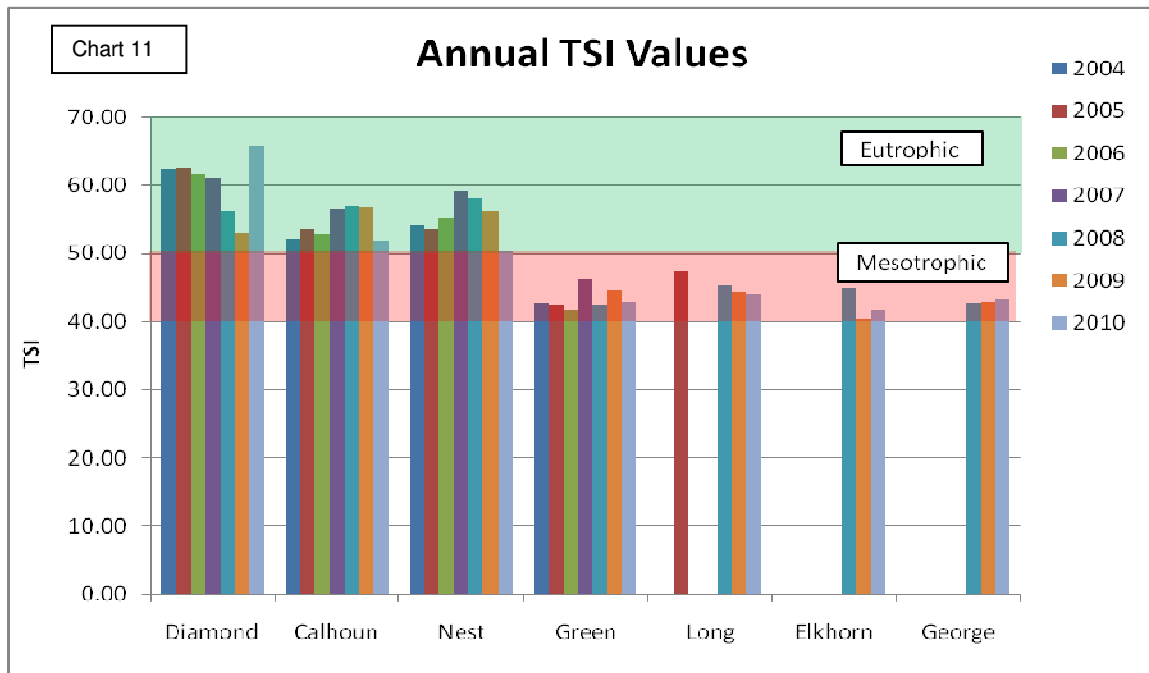


Chart 10 shows the results for average annual total phosphorus (TP) from 2007 through 2010. The shaded area indicates the ecoregional average for TP. In 2010, Long, George, Nest, Elkhorn, Green, Calhoun, and Monongalia were within or better than the ecoregional average, indicating good to excellent water quality. Diamond Lake exceeded the ecoregional average, indicating poor water quality.



Another method that can be used to determine the overall health of a lake is Carlson's Trophic State Index (TSI). Trophic state indicates the overall productivity, or plant and algae growth, occurring in a lake. The TSI uses algal biomass as its basis and is determined by using three productivity parameters: total phosphorus, chlorophyll-a, and secchi disk.

Chart 11 shows the average annual trophic state index from 2004 through 2010. In 2010, Diamond, Calhoun and Nest lakes were classified as eutrophic, meaning they displayed periods of fairly heavy algae blooms. Green, Long, Elkhorn and George lakes were classified as mesotrophic in 2010, meaning they experienced lighter algae blooms during the summer and have good water clarity.



TSI 30-40 Oligotrophic – clear water, hypolimnion oxygenated throughout the year (except in shallow lakes)
TSI 40-50 Mesotrophic – Water moderately clear, but anoxia becoming more likely in hypolimnion during the summer
TSI 50-60 Lower Boundary of classical eutrophy: Decreased transparency, anoxic hypolimnia during the summer, aquatic plant problems evident, warm water fisheries only.
TSI 60-70 Eutrophic: Dominance of blue-green algae, algal scums probable, extensive aquatic plant problems
TSI 70-80 Hypereutrophic: Heavy algal blooms possible throughout the summer, dense aquatic plant beds, but extent limited by light penetration.

Hypolimnion – the dense, bottom layer of water in a stratified lake. Typically the coldest layer in the summer and the warmest in the winter

After Moore, I. And K. Thornton [Ed.] 1988. *Lake and Reservoir Restoration Guidance Manual*. (Doc. No. EPA 440/5-88-002) Source: MINNESOTA POLLUTION CONTROL AGENCY/ Volunteer Surface Water Monitoring Guide, 2003 <http://www.pca.state.mn.us/water/lakeacro.html>

Improving Water Quality

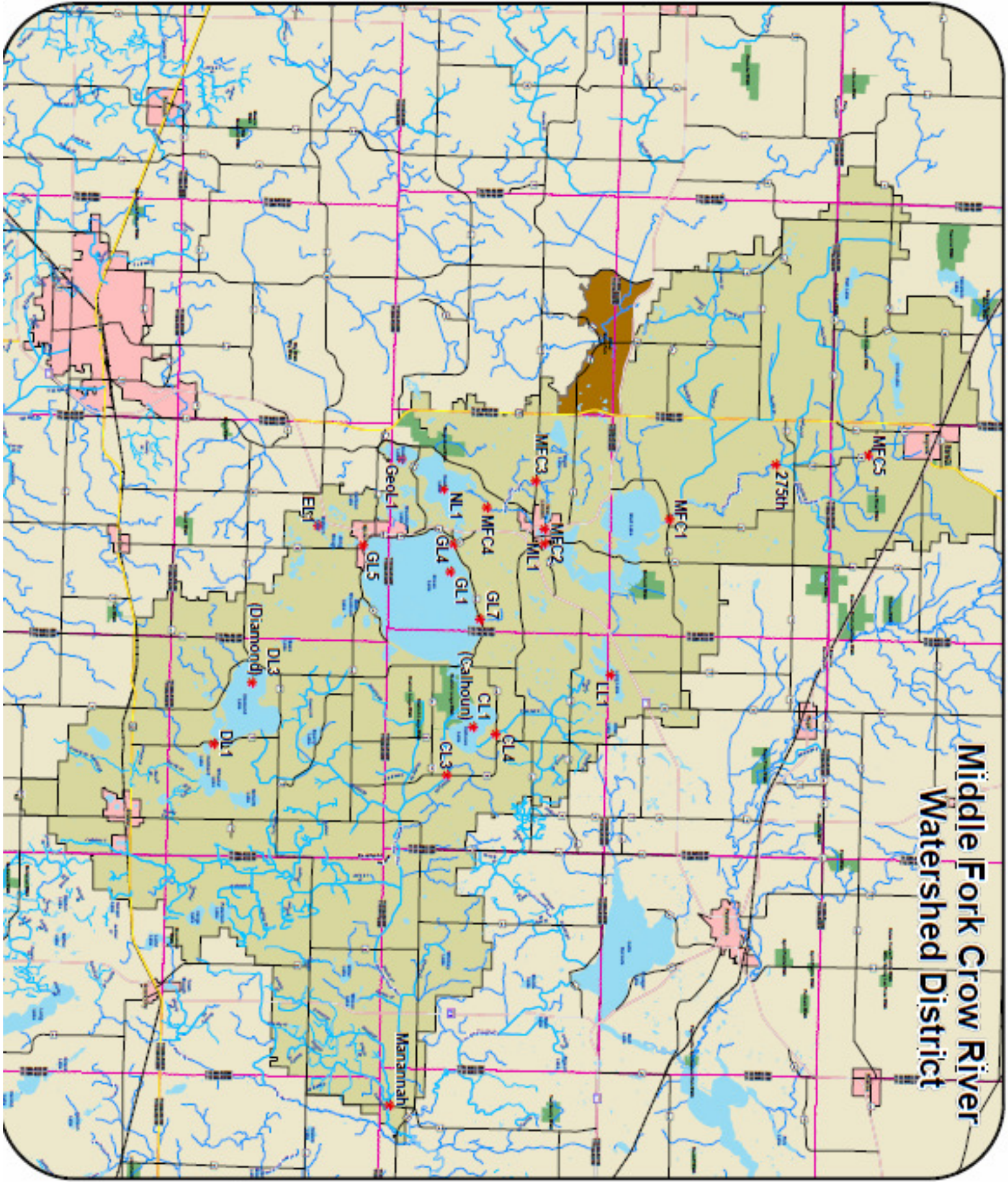
In addition to monitoring water quality throughout the watershed, the MFCRWD also assists landowners with the implementation of best management practices (BMPs). BMPs are practices that help protect and improve water quality by reducing the amount of nutrients and sediment that reach our local water bodies. To encourage property owners to implement BMPs, the Watershed District provides educational opportunities along with technical and financial assistance. Examples of eligible projects include shoreland and stream restorations, raingardens, wetland restorations, buffer strips, animal exclusions and many more. So what does this mean for water quality in your lake?

One way to understand the cumulative impact of all these BMPs is to review the projects that have been implemented in your lake's watershed - the area of land that drains into your lake, including the lake itself. The table below shows the number of BMPs that have been implemented throughout the watershed of each major lake by the MFCRWD through 2010. Across the entire Middle Fork Crow River watershed, 35 BMPs have been installed, decreasing the phosphorus entering surface water by more than 148 pounds per year and the sediment by almost 128 tons per year. Those 35 BMPs include 4 agricultural BMPs, 5 raingardens, 16 shoreland restorations, 5 stream restorations, and 5 stormwater BMPs.

Lake	Total # of BMPs in the watershed of this lake	Total Phosphorus Reduced in the watershed of this lake	Total Sediment Reduced in the watershed of this lake
Elkhorn Lake	0	0 lbs/yr	0 tons/yr
Long Lake	1	2.53 lbs/yr	2.98 tons/yr
Monongalia Lake	6	20.50 lbs/yr	15.77 tons/yr
George Lake	1	0.94 lbs/yr	1.10 tons/yr
Nest Lake	15	47.81 lbs/yr	47.88 tons/yr
Green Lake	23	62.55 lbs/yr	64.99 tons/yr
Calhoun Lake	1	0.78 lbs/yr	0.92 tons/yr
Diamond Lake	5	33.30 lbs/yr	1.38 tons/yr
Entire Middle Fork Crow River watershed	35	148.06 lbs/yr	127.79 tons/yr

Along with the land use changes of best management practices, behavioral changes are also important to meet the goal of keeping our local lakes and rivers healthy for everyone to enjoy. Currently the staff is working on two research projects: a Stormwater and Eurasian Watermilfoil study on Green Lake and a Conservation Drainage study near Atwater. The MFCRWD also offers many educational opportunities to inform residents of their local water resources and engage them in activities that make a positive impact on them. The District will be holding workshops on shoreland restorations, raingardens, and stormwater for adults. In addition, District staff have teamed up with local teachers on the S.T.R.E.A.M. (**S**tudent-**T**argeted **R**esource **E**ducation, **A**wareness, and **M**anagement) program to teach students about water quality issues and how they can impact our water resources positively.

Middle Fork Crow River Watershed District



- Legend**
- Water Quality Monitoring Site
 - County Roads
 - Ditches
 - US Highway
 - National
 - State Highways
 - Townships
 - Lakes
 - Rivers
 - County Boundaries
 - Municipalities
 - Wildlife Management Areas
 - State Parks
 - Large Watershed Boundaries

